
All Quiet on the Eastern Front?

Disruption Scenarios of Russian Natural Gas Supply to Europe

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- Security of Russian natural gas supplies is high on the agenda – once more
- Different perspectives can be taken:
 - Russia: Exports, budget
 - Ukraine: Dependency, energy efficiency
 - EU: Energy Union, political and economic sanctions
- DIW Berlin prepared a larger study on Gazprom's role in infrastructure and gas distribution companies in East, Central and West Europe as well as disruption scenarios of Russian gas supply

1 Same, same but different ? A comparison between 2009 & 2014

1. Less Russian transits to Europe via Ukraine (Nord Stream)
2. Lower share of EU imports from Russia
3. Expanded intra-European interconnectors (EC 994/2010)
4. Expanded EU LNG import capacity by 15%
5. Natural gas production boom in the USA
6. Increased Asian LNG imports (Fukushima disaster)
7. Reduced EU consumption of natural gas by 4%

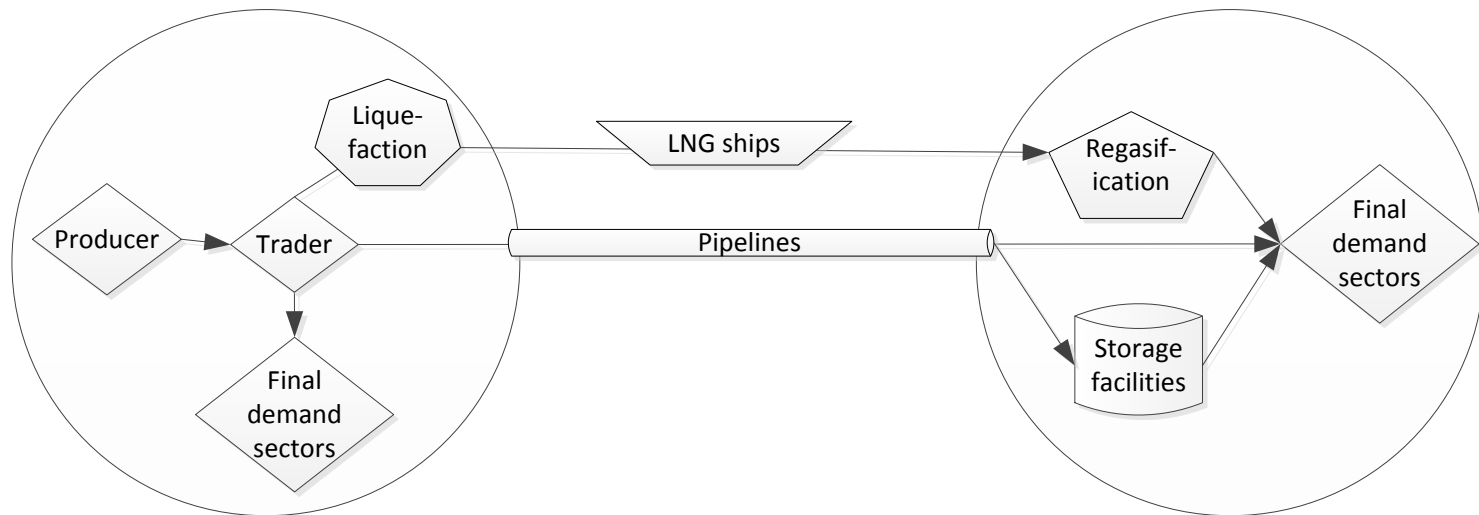
Disruption Scenarios with the Global Gas Model

What is the impact of interrupted Russian natural gas exports to Europe?

- Application of Global Gas Model to simulate disruption scenarios
 - Transit disruption via the Ukraine
 - Disruption of all (represented) “Gazprom”-owned infrastructure
- Focus on global effects
 - Reaction of other suppliers
 - Competition for internationally supplied natural gas (e.g. LNG)
- Identification of infrastructure bottlenecks (at the country level)
- Both short-term and long-term effects

“Multi-agent economic game on an underlying transportation network”

- Partial equilibrium model of the global natural gas market
- 94 regional nodes in 74 countries
- Optimization problems of different players along the value chain
- Market power for selected trade relations
- Seasonal demand
- Endogenous investment in storage and transportation infrastructure



Representation of the natural gas market and supply chain in GGM (joint work with R. Egging)

- Naturally, the GGM abstracts from some observable circumstances
- No institutional friction
 - No oil-price linkage representation
 - No long term contracts taken into account
- Assumptions on production capacities
 - Relevant for short-term production increase
 - Here: critical for Norway and the Netherlands
- No intra-country pipeline networks (bottlenecks)
- No short-term reaction (within 1 year) possible vis-à-vis capacity expansions / reverse flows
- Fuel substitution only indirectly modeled by inverse demand functions
- Disruption shock in projected world for 2015 (not exactly the same as today)

Definition of Scenarios

Scenario Name	Description
Base	<p><u>Base Case:</u></p> <ul style="list-style-type: none"> • Projections of natural gas production and consumption based on the NPS of the WEO 2012 (IEA, 2012)
UKR Disruption	<p><u>Ukrainian Disruption:</u></p> <ul style="list-style-type: none"> • Interruption of Russian pipeline connection to Ukraine in 2015 (direct and via Belarus)
Gazprom	<p><u>Disruption of Gazprom infrastructure to Europe (incl. Turkey):</u></p> <ul style="list-style-type: none"> • Reduction of total cross-country pipeline and storage capacity in 2015 that is currently majority-owned directly and indirectly by Gazprom (exception for Belarus) <p>Affected pipelines:</p> <ul style="list-style-type: none"> • Nord Stream • Brotherhood • Yamal Europe • Blue Stream • South Stream • OPAL <p>Affected storage facilities:</p> <ul style="list-style-type: none"> • Rehden in Germany • Haidach in Austria • Incukalns in Latvia • Banatski Dvor in Serbia
Long Disruption	<p>Same coverage as in „Gazprom“ From 2015 to 2040</p>

Short-Term Disruption Scenarios in 2015 with the Global Gas Model

Differences in Consumption Levels relative to the *Base Case*

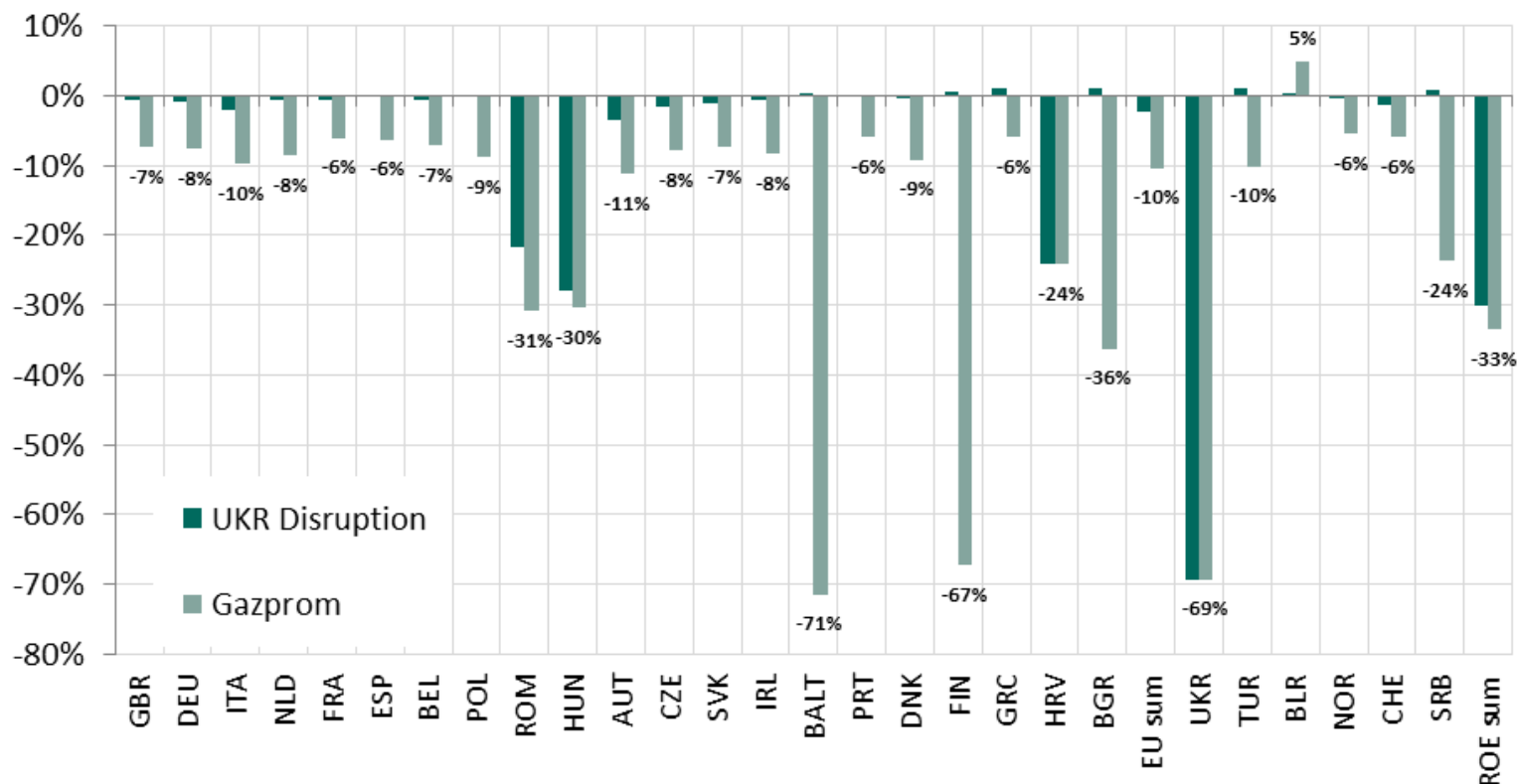


Figure: Changes in 2015 consumption levels relative to the Base Case, in percentages. Values for the *Gazprom* scenario are provided next to the respective bars.

- Effect on EU rather small on average (-2% *UKR Disruption*; -10% *Gazprom*)
- Variation across countries
 - Most affected: Ukraine, the Baltic, Finland, Romania, Hungary & Croatia

Consumption prices relative to the *Base Case*

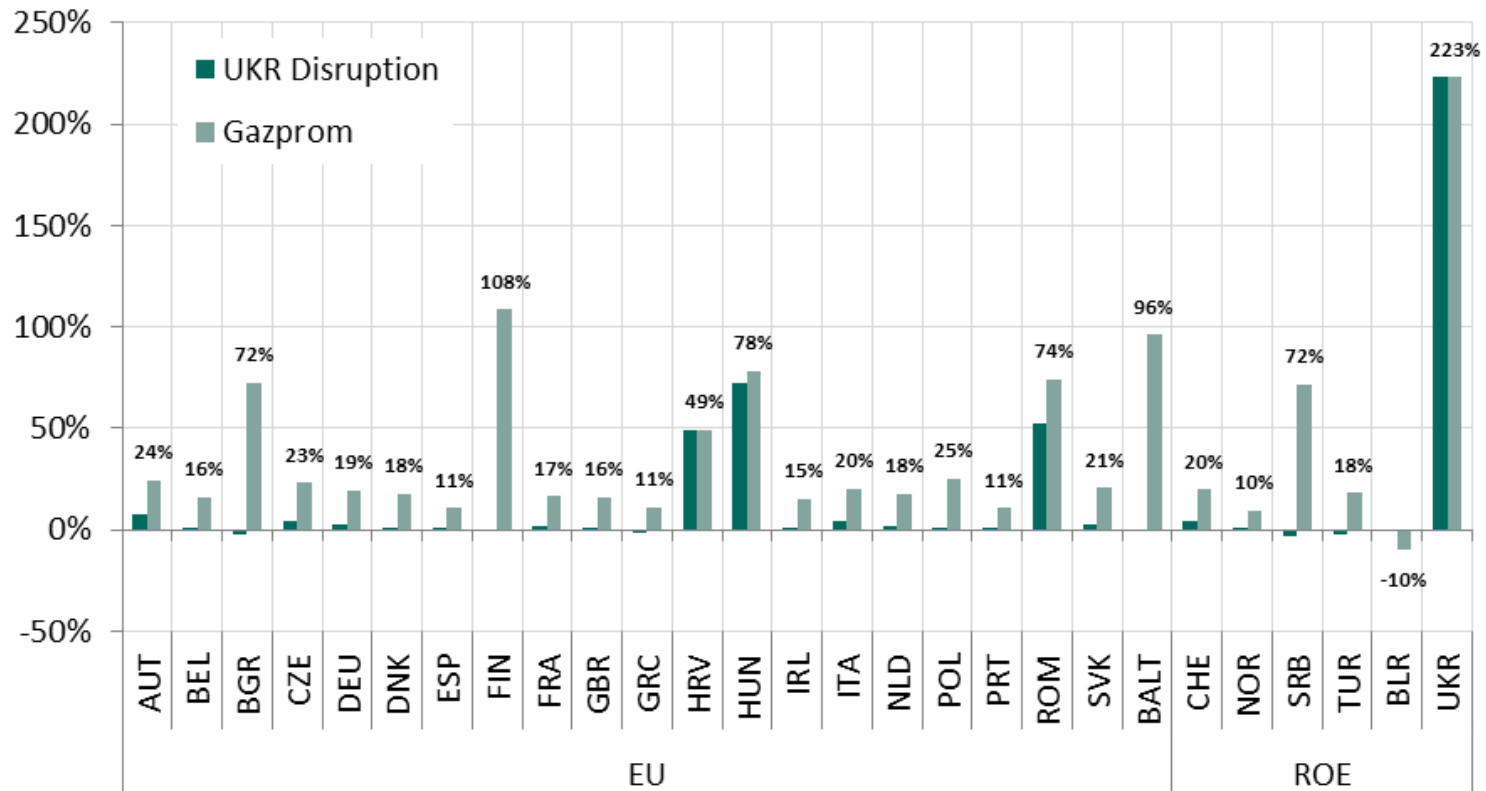


Figure: Prices in 2015 relative to the Base Case, in percentages. Values for the *Gazprom* scenario are provided next to the respective bars.

- Equilibrium is represented by price-quantity pairs, i.e. similar impact
- Increase of prices by more than 10% for all EU countries in *Gazprom*

EU Import Structure – *Base Case vs Gazprom Scenario*

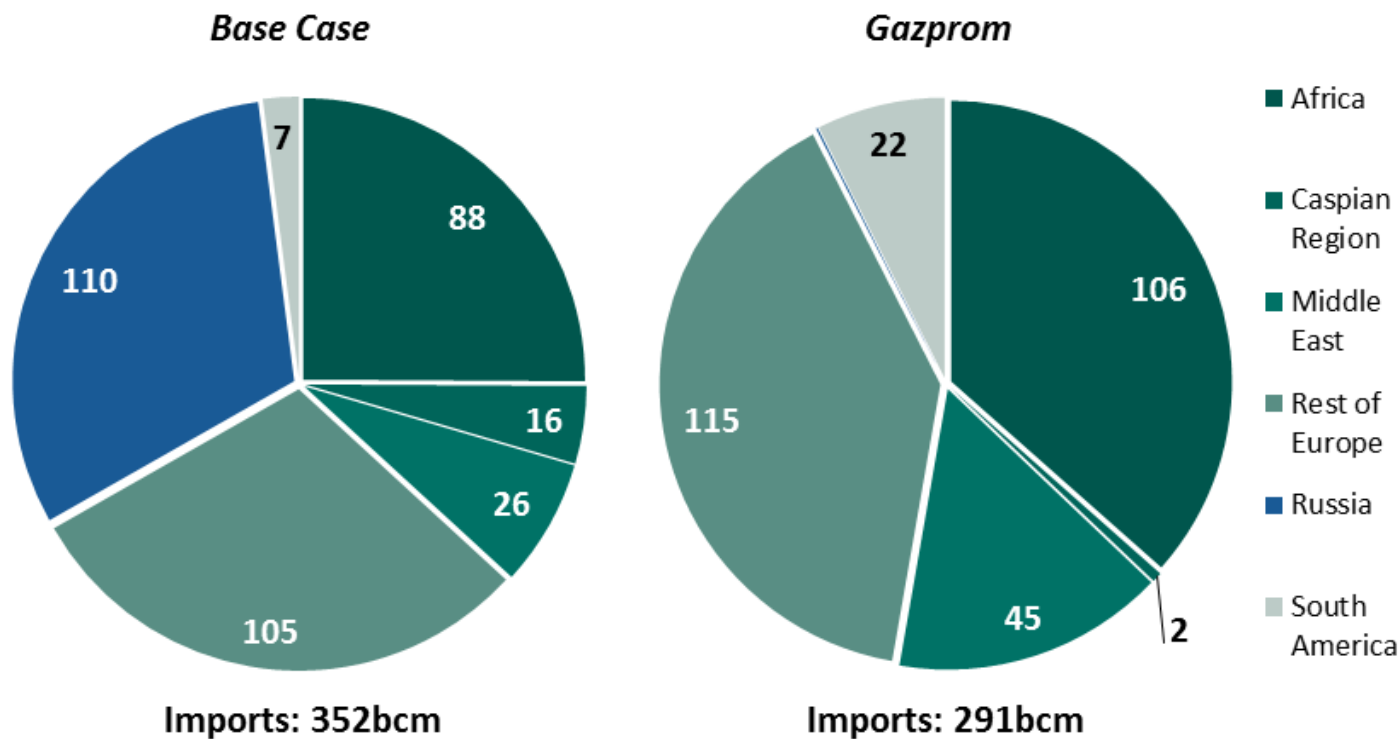


Figure: EU import structure in 2015 by supplier, in bcm.

- Shift in EU import structure from Russia and the Caspian region
- Increase from Africa, the Middle East, Norway and South America

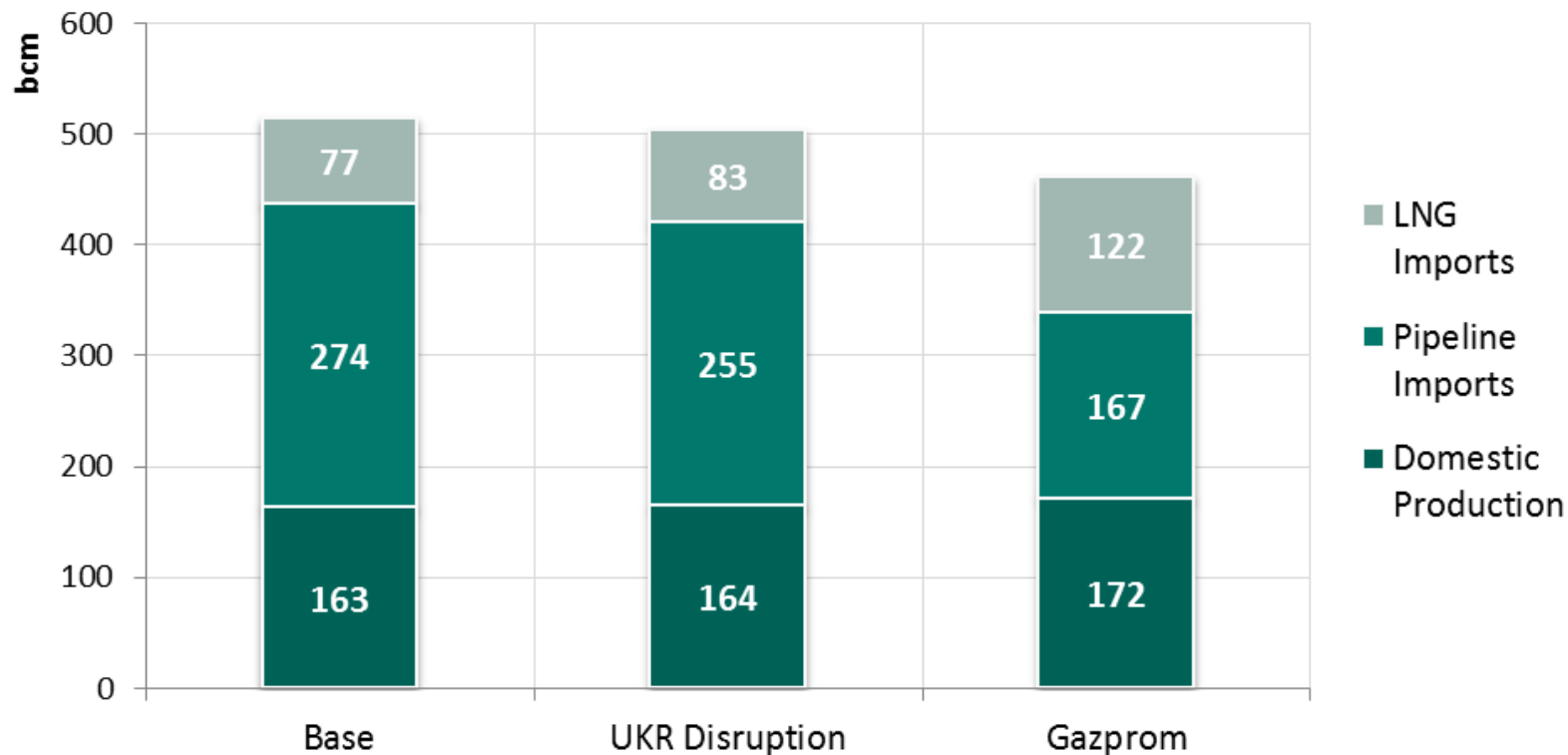


Figure: EU supply structure in 2015 across scenarios, in bcm.

- Replacement of pipeline imports by domestic production and LNG imports
- LNG imports increase by almost 50% (from MEA, SAM, and AFR)
 - Increase in global LNG supply, shift from Asia toward Europe (global balancing)

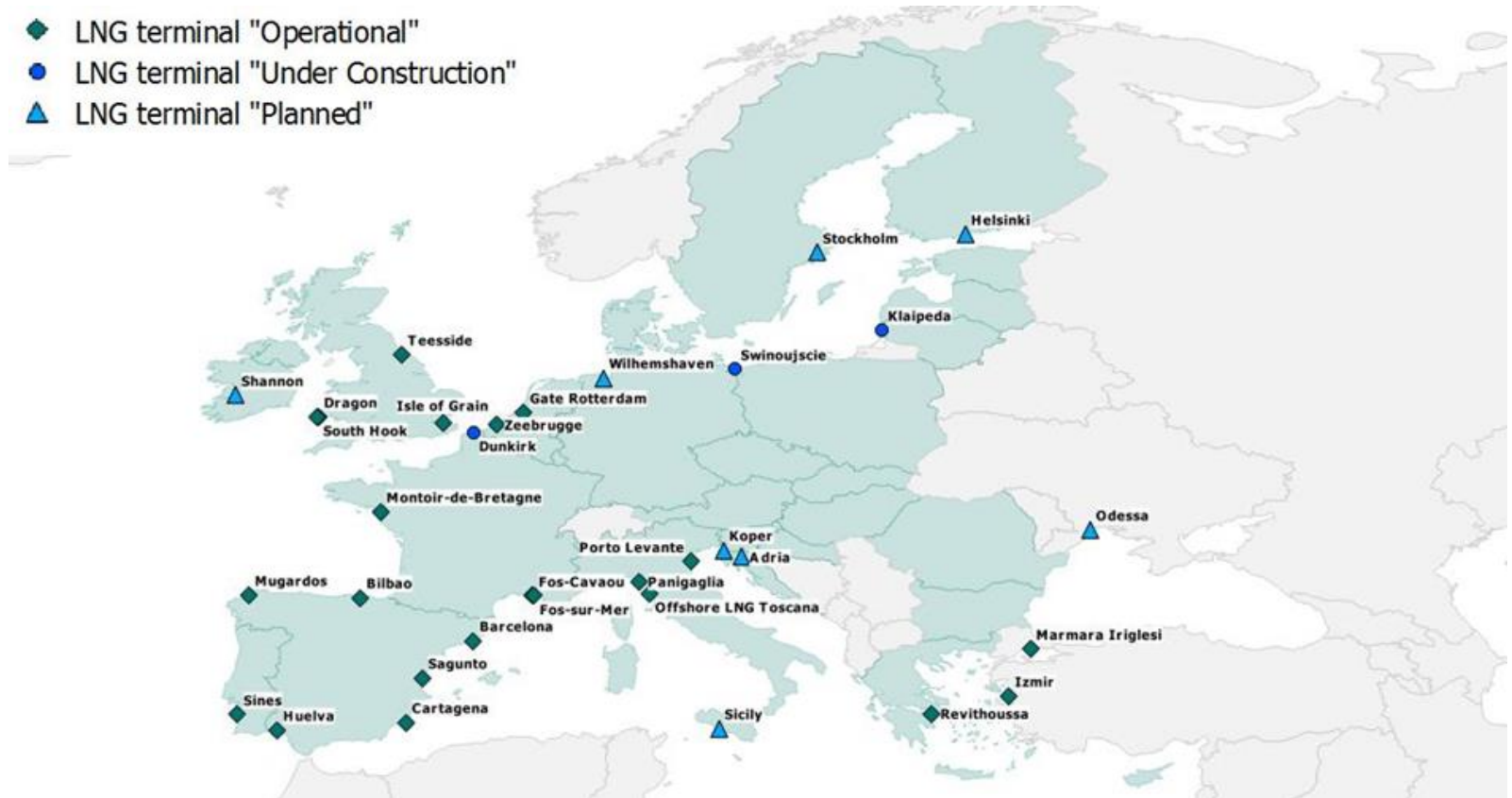


Figure: LNG imports terminals in Europe, which are “operational”, “under construction” and “planned”.

- Large EU LNG import capacities of 195 bcm
- Intra-European pipeline bottlenecks hamper efficient import balancing

LNG Imports of EU Countries vs Capacities

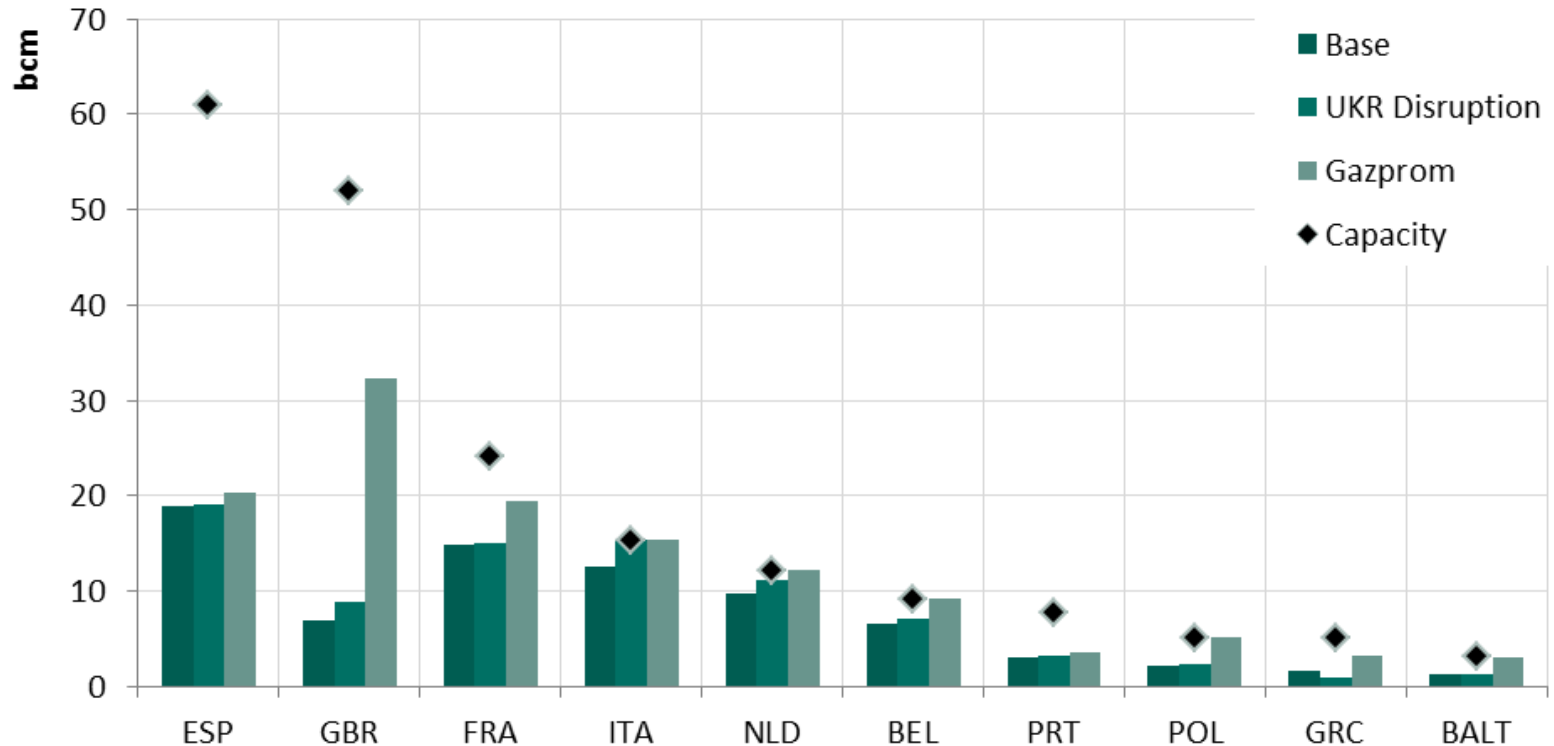


Figure: EU LNG imports in 2015 by countries compared to potential regasification capacity (bcm).

- LNG imports increase particularly in the UK and Italy
- Low utilization rates in several countries, especially in Spain (33%)

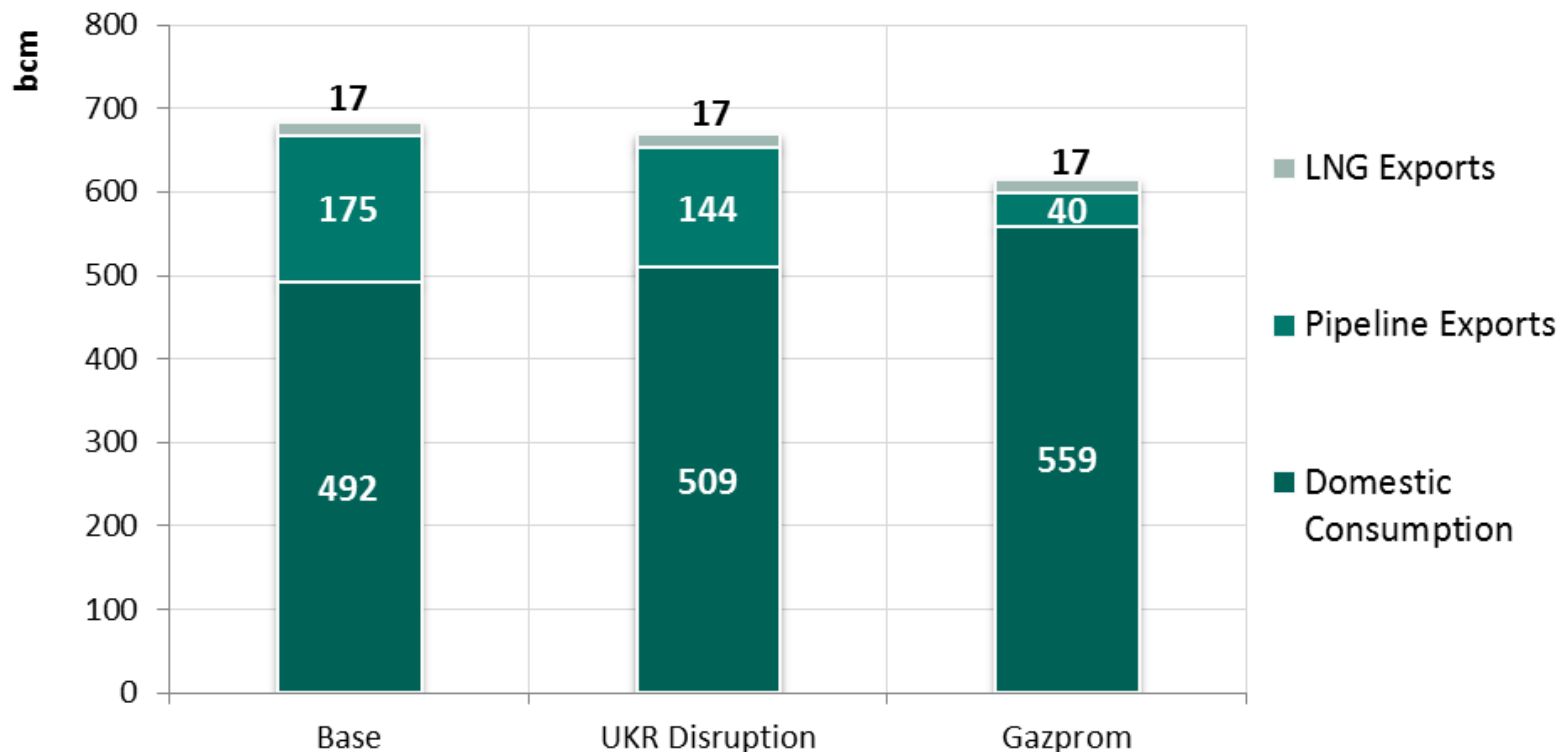


Figure: Supply structure of Russian production in 2015 across scenarios, in bcm.

- Strong reduction in Russian exports due to limited export possibilities
- Small export capacities of LNG and pipeline (toward China and the Caspian region)

Long-Term Disruption with the Global Gas Model

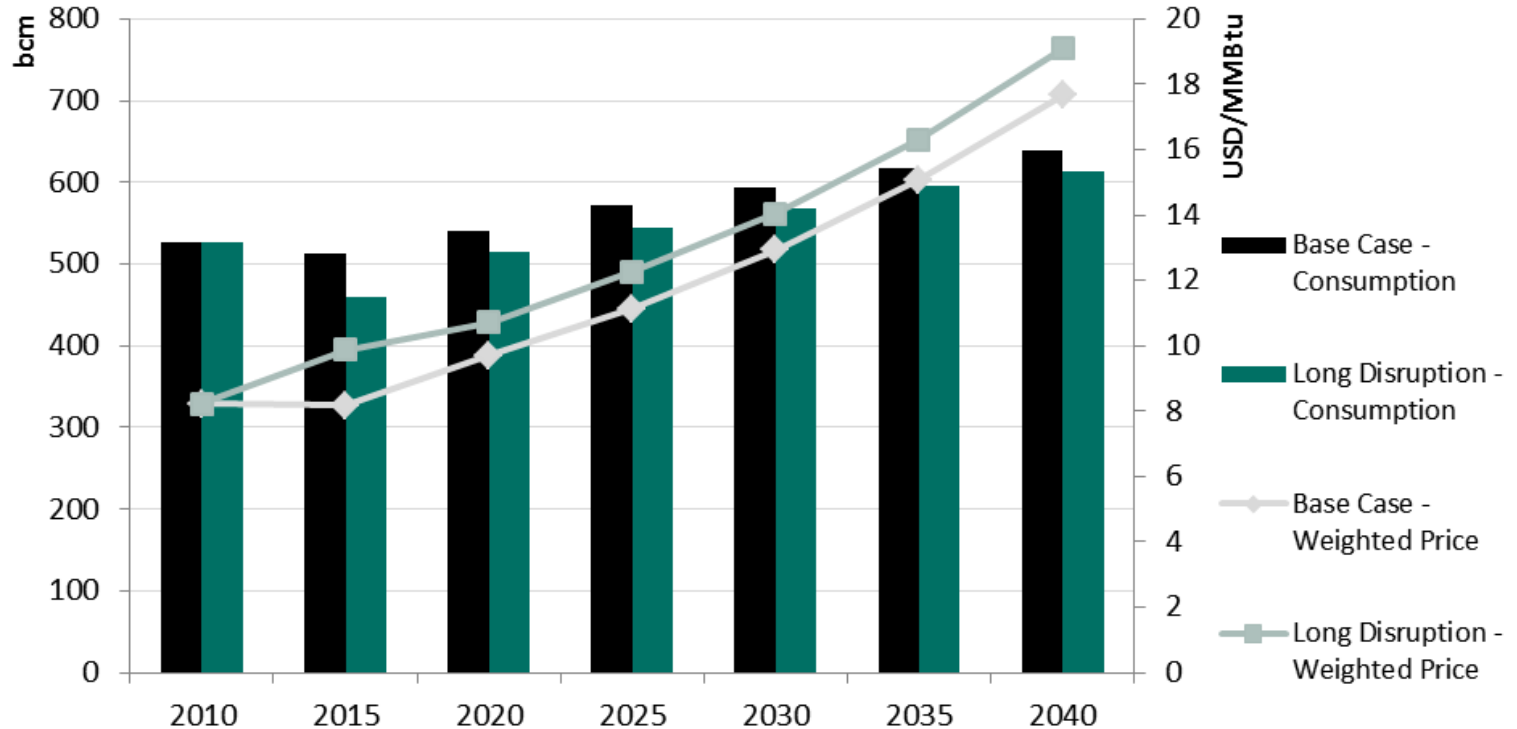


Figure: Natural gas consumption (left axis) and weighted prices (right axis) in the EU over time and across scenarios, in bcm and USD/MMBtu..

- Sizeable reduction of consumption in the long run, i.e. not all Russian gas exports can be replaced, despite higher prices
- Largest effect in start year of disruption, i.e. 2015

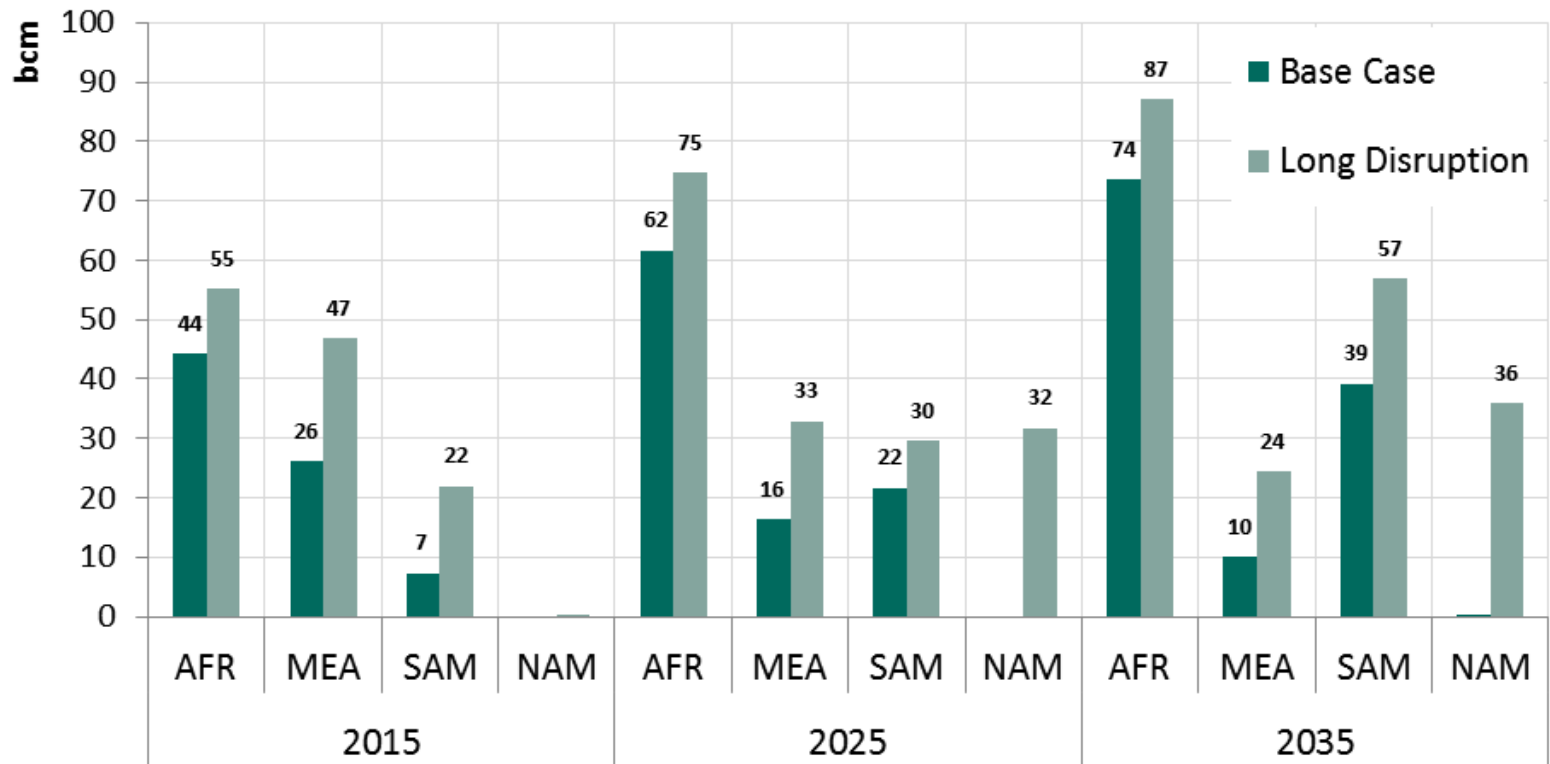


Figure: LNG imports to the EU by destination region, in bcm.

- Russian exports partly replaced by LNG supplies to Europe
- North American LNG exports to Europe are economic in this situation

Expansion of Import Infrastructure to Europe

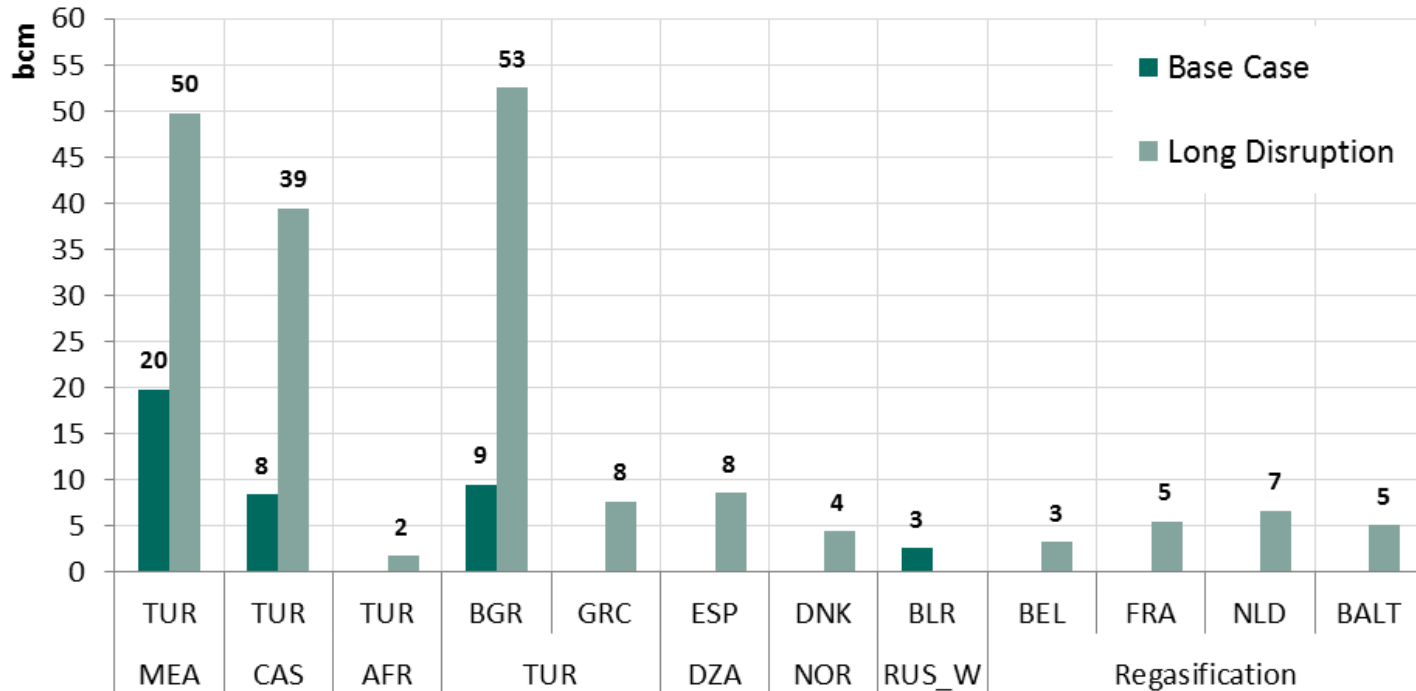


Figure: Expansions of import infrastructure to Europe in 2015 in the Base Case and Long Disruption, in bcm.

Note: The lower part of the horizontal axis is the pipeline's origin, or classifies location of regasification terminals.

- Russian exports are largely replaced by supplies from the Middle East and Caspian which require new pipelines to replace Ukrainian transit system
- Additional LNG imports trigger new regasification terminals

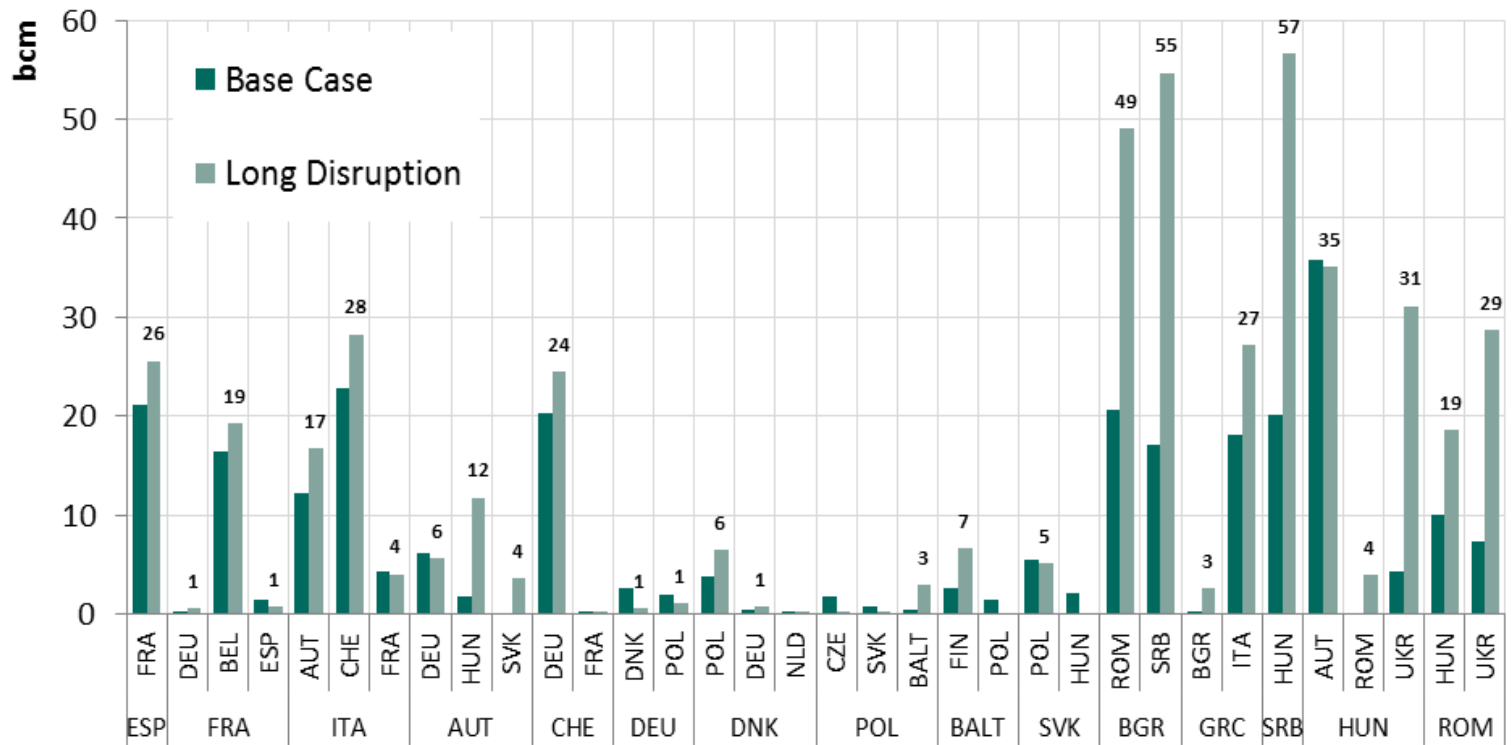


Figure: Cumulative intra-European pipeline expansions until 2040, in bcm.

Note: The lower part of the horizontal axis is the pipeline's origin.

- Replacement of Russian supplies with exports from the Middle East and Caspian also requires new pipelines in Eastern Europe
- Spanish LNG terminals are better linked to other markets

Conclusions

- Disruption of Russian natural gas exports have
 - Severe impact on some (mainly neighboring) countries in Europe
 - Rather small average effect on EU consumption on average with up to -10% consumption reduction
- Relaxation of intra-European pipeline bottlenecks could further reduce the negative impact of disruption
 - Capacities enabling reverse flows toward Eastern Europe
 - Pipeline capacities from Spain via France and from Italy toward Central Europe for LNG imports and North African Gas
- In the medium-term, the EU and the Member States should work towards a reduced exposure to natural gas imports, involving increased efficiency, the further decarbonization of the energy system

Thank you for your attention.



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